Patient Satisfaction with Mobile Teledermatology in the Pre- and Post-COVID-19 Pandemic: A Systematic Review

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Abstract

The necessity for telemedicine services heightened with the onset of the COVID-19 pandemic, resulting in their implementation in areas where they were previously unavailable, aided by mobile devices and their applications. This review compares patient satisfaction with mobile teledermatology before and after the pandemic to identify factors affecting satisfaction and improve the patient experience. Primary studies measuring patient satisfaction with mobile teledermatology for consultation, triage, and follow-up between March 17, 2017, and March 17, 2023, were searched in PubMed, CINAHL, Cochrane databases, and Google Scholar. Ten studies were included and divided into pre- and post-pandemic groups. Demographic data, domain-specific satisfaction scores, general satisfaction scores, and qualitative responses were extracted for analysis.

All the reviewed studies indicated that patients exhibited high satisfaction levels. Factors influencing satisfaction positively before the onset of the pandemic included swift response times, rapid data transfer, and reliable connectivity. Conversely, following the onset of the pandemic, satisfaction was positively associated with convenience, concerns about contact with the COVID-19 virus, and the type of diagnosis. Conversely, after the pandemic began, factors such as poor connectivity, application complexity, age, low IT literacy, inadequate communication, fragmented care, increased costs, and gaps in the health value chain contributed to negative satisfaction. Common factors observed in both periods included patient follow-up, time management, self-photography, direct costs, prior heavy mobile phone usage, intricate mobile applications, and the integration of artificial intelligence. It is possible to develop mobile messaging applications with a teledermatology feature to facilitate communication with other components of the health value chain.

Keywords: *Telemedicine, Mobile Teledermatology, Patient Satisfaction, COVID-19 Pandemic*

1. Introduction

The formal announcement of the SARS-CoV-2 virus (COVID-19) as a pandemic on March 11, 2020, by the World Health Organization led to measures such as lockdowns to enforce social distancing and curb its spread. These measures increased the distance to healthcare access. Telemedicine utilizes information communication technology to deliver healthcare over a distance (Pan American Health Organization, 2016) and was useful in bridging the distance to care access occasioned by the pandemic (Elsner, 2020). It is classified using technology, considering the timing of encounters and the type of technology used for the encounter, whether dedicated teleconferencing equipment, mobile devices, or computers. The classifications are live interactive (LI) or synchronous, which utilizes videoconferencing equipment with participants in real-time contact concurrently at a distance, and the store and forward (SAF) or asynchronous, which involves a timed delay for the assessment of clinical information and images. The hybrid involves concurrent utilization of both the synchronous and asynchronous (Lee, & English, 2018).

Teledermatology, described by Perednia (1995) as telemedicine for dermatology, is stratified into interaction levels depending on the involved actors. The primary level involves the general practitioner and the patient; the secondary level involves the general practitioner and the specialist dermatologist; the tertiary

level involves two dermatologists consulting each other, such as a general dermatologist to a subspecialty dermatologist, and the level of the patient directly to the dermatologist (Tensen et al., 2016).

There is no consistent definition of satisfaction (Hadeler et al., 2021) One definition describes it as the post-experience phenomenon of how patients express their misgivings of service after going through it. It has been used as a measure of the effectiveness of innovations and as a key outcome of care (Ofili, 2014), highly dependent on the user of a service and on different domains based on the field it is in (Alrubaiee, & Alkaa'ida, 2011). Satisfaction is a multidimensional construct, with different domains contributing to its perception. For this reason, instruments measuring it should consider its multidimensional nature and highlight the various aspects of service for respondents to express their opinion on each; in essence, measuring general satisfaction alone should be avoided (Ofili, 2014). The importance of these dimensions depends on the respondents involved. The dimensions, or domains, are interwoven in a complex way that can affect satisfaction (Garcia, & Adelakun, 2019). For teledermatology, the environment (physical and virtual), interpersonal relations, technical quality, efficacy, accessibility, availability, continuity, and cost were domains identified with patient satisfaction (Hadeler et al., 2021) alongside the impact on daily life and usability (Wang et al., 2018).

There are various instruments utilized to measure satisfaction, but there is no single standardized instrument. Most instruments are questionnaire-based, with nine of these being specific to telehealth. They typically assess different constructs, vary in the number of questions, and target different populations (Langbecker et al., 2017). Many studies adapt these questionnaires to accommodate cultural differences (Yadav et al., 2022). Additionally, non-questionnaire-based instruments exist, such as visual analog scales (Heidemeyer et al., 2023).

Comparison of asynchronous and in-person consultations did not reveal appreciable differences in satisfaction (Collins et al., 2004), nor did comparison with synchronous methods. However, some respondents favored synchronous consultations over in-person encounters due to the attention received from the consulting physician (Hicks et al., 2003). Satisfaction comparisons between the SAF and LI methods showed no significant difference (Mounessa et al., 2018). More recently, a review found high satisfaction with teledermatology across various studies (Hadeler et al., 2021).

Mobile devices pose limitations when utilized for telemedicine and teledermatology. Among these limitations are technological constraints stemming from disparities between devices (Wang et al., 2018), particularly differences in hardware and software capabilities (Franklin et al., 2020). These challenges underscore the multidimensionality of IT-based innovations (Gagnon et al., 2012), exacerbated by decreased ICT proficiency among older individuals and those with lower educational attainment (Handa et al., 2021; Wang et al., 2018). Such factors can impact satisfaction and, consequently, widen the gap in accessing care (Handa et al., 2021), contrary to the anticipated increase in access.

Prior to the pandemic, studies were conducted to measure satisfaction with mobile teledermatology, utilizing smartphones and mobile applications (Wang et al., 2018), even in subspecialties such as pediatric dermatology (Fiks et al., 2018). Similarly, studies on satisfaction with mobile teledermatology were carried out during the pandemic, prompting further refinement of the process (Handa et al., 2021).

However, there is a lack of reviews specifically comparing user satisfaction with mobile devices for dermatology care before and after the pandemic to determine if there were any significant changes in satisfaction between the two periods. It is noteworthy that the pre-pandemic period was characterized by normalcy, while the post-pandemic period saw the emergence of lockdowns and social distancing measures, compelling patients to resort to unconventional methods of accessing care. The pandemic has provided an opportunity to examine how transitioning from a period of choice to one with limited options impacts satisfaction with an innovation, particularly considering its increased utilization, which is almost nonexistent

in some areas (Handa et al., 2021). This comparison will shed light on whether there was a noticeable increase or decrease in patient satisfaction between these two periods, or if there was no discernible change. Such an assessment is crucial for evaluating the effectiveness of the innovation of mobile teledermatology, as satisfaction can serve as a measure of effectiveness and is considered a key outcome of care (Ofili, 2014). It will inform future decisions regarding whether to continue investing in enhancing the process or to discontinue it altogether if deemed unsatisfactory.

Of importance as well is to identify the factors that either positively or negatively influenced patient satisfaction with mobile teledermatology for accessing care during the two periods. This will aid in pinpointing areas where the innovation may have fallen short or where adjustments can be made to enhance user satisfaction, thereby preparing for any future unpredictable situations similar to the COVID-19 pandemic period.

Furthermore, satisfaction is a multidimensional construct that cannot be adequately explained by general satisfaction alone due to the various factors that can influence its perception (Ofili, 2014). Therefore, it is measured across different service domains where these factors can be categorized. The significance of these domains also varies depending on the types of respondents involved, and they are not universally applicable to every satisfaction study (Garcia, & Adelakun, 2019).

2. Objectives

1) Compare patients' satisfaction with mobile teledermatology, pre- and post-onset of the COVID-19 pandemic.

2) Identify factors associated with increased or decreased satisfaction with mobile teledermatology, pre- and post-onset of the COVID-19 pandemic.

3. Materials and Methods

For this study, eligible mobile devices must have the capability for internet connectivity via a mobile network provider SIM card or Wi-Fi. They should also be capable of conducting voice or video calls through the internet or mobile networks, as well as supporting instant messaging application software. These devices encompass mobile/smartphones and tablets manufactured by any company, operating on Apple iOS, Microsoft, or Android operating systems, and utilizing mobile software applications (Franklin et al., 2020).

Figure 1 below illustrates the flow of the search strategy, which we segmented into two stages: identification and screening. During the identification stage, we first developed keywords aligned with the SPIDER mnemonic: patient, satisfaction, teledermatology, COVID-19, questionnaire, and qualitative. For each database, we initiated both an initial basic search and an expanded search using the advanced search function, incorporating synonyms of the aforementioned keywords. We executed a series of Boolean search strings across the CINAHL, Cochrane, PubMed databases, and Google Scholar (supplementary search) to pinpoint primary studies spanning from March 1, 2017, to March 1, 2023. Additionally, the Google Scholar search engine facilitated forward and backward citation searches on the studies identified at the conclusion of our screening process for the keyword and database searches.

For instance, in the CINAHL database, we employed the following Boolean search for the basic search: ("telemedicine"[Mesh] OR Telemed*[tiab] OR Teledermatology*) AND (patient satisfaction [tiab] AND (dermatology [Mesh] OR dermatology[tiab] OR skin[tiab]).

For the advanced search, we expanded the keywords as follows:

((teledermatology[Title/Abstract]) OR (telemed*[Title/Abstract])) OR (smartphone[Title/Abstract])) OR (cellphone[Title/Abstract])) OR ("mobile application"[Title/Abstract]))

OR ("store and forward"[Title/Abstract])) OR ("mobile health"[Title/Abstract])) AND ("patient satisfaction"[Title/Abstract])) AND ((skin [MeSH Terms]) OR (dermatology [MeSH Terms]).

The addition of the keywords COVID-19 produced studies that were a subset of the advanced search. However, the inclusion of either qualitative or quantitative did not yield any results.

For Google Scholar, we conducted a single search using the advanced search function: (teledermatology* OR telemed* AND "mobile application*" OR smartphone OR Mobile health OR "store and forward" AND "patient satisfaction" AND dermatology OR skin -systematic review).

The Zotero software was used to pool the identified studies from the various database searches, and it was also used to identify and remove duplicate studies.

During the screening stage, the initial step involved assessing the relevance of study titles and abstracts to our research question. We categorized studies into two groups based on the clarity of their titles and abstracts. In the subsequent step, we endeavored to obtain the full articles of the studies. This process encompassed reaching out to study authors via email to request the full articles and seeking clarification on the content of the retrieved articles, particularly for those studies where we were uncertain of their relevance to our research question. Each retrieved article underwent eligibility screening using our predefined inclusion and exclusion criteria, followed by a checklist review of the study methodology to assess the risk of bias.

Additional studies were found through forward and backward citation searches using the Google Scholar search engine. We looked for citations of the studies included in our database Boolean search, eliminated duplicates with the Zotero application, assessed relevance to our research question, obtained the full articles, and screened them again based on our inclusion and exclusion criteria to determine which articles to include.

We included studies conducted in English, focusing on the use of mobile devices/smartphones for skin disease consultation, diagnosis, and monitoring. These studies qualitatively or quantitatively measured patient satisfaction with teledermatology within the period from March 1, 2017, to March 1, 2023. The selection of studies was based on the timeframe of when the research was conducted rather than when it was published.

We divided the final studies into two groups, pre-onset of the COVID-19 pandemic from March 1, 2017, to March 1, 2020, and post-onset of the COVID-19 pandemic from March 2, 2020, to March 1, 2023. 3 years pre-onset and 3 years post-onset of the pandemic.

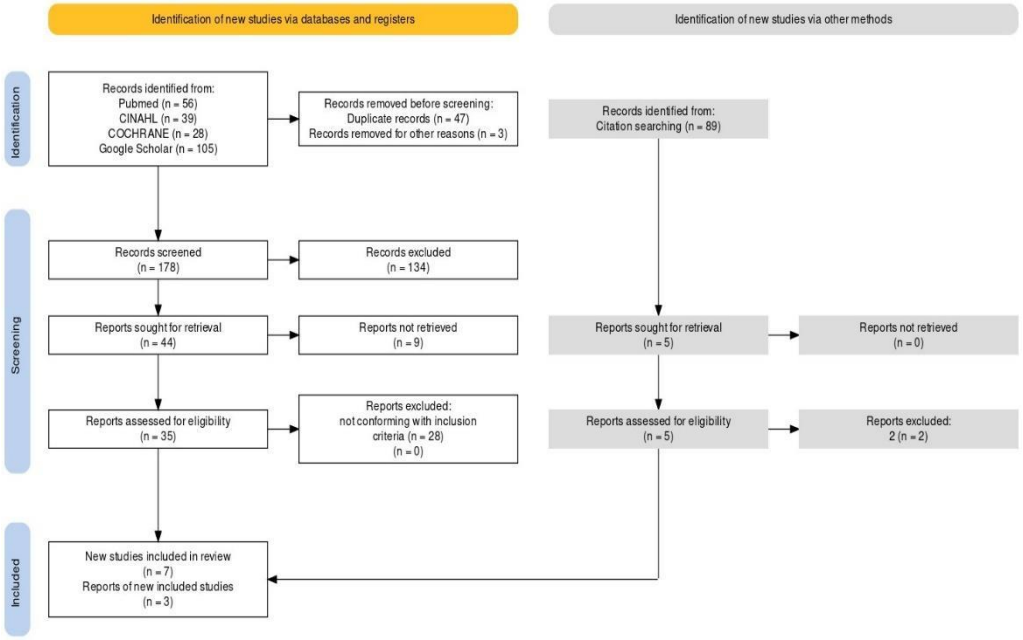

Figure 1 PRISMA flow diagram of search strategy showing the identification and screening phases.

We proceeded to extract data based on the context of respondents, including age, population characteristics, and skin condition, as well as the level of teledermatology and technology utilized. We also considered study design contexts, such as the type of mobile device or application used, along with satisfaction measurement tools employed. Additionally, we collected general satisfaction scores from questionnaires that included a general satisfaction question, qualitative data, factors influencing satisfaction from study results, and the overall conclusions regarding satisfaction levels, whether high or low.

4. Results and Discussion

4.1 Results

Ten studies, encompassing a total of 7767 respondents, were included in the analysis. Among these, four were conducted pre-COVID-19 onset, while six were conducted post-COVID-19 onset. One of the pre-COVID-19 onset studies utilized mobile devices for general dermatologic diseases (Wang et al., 2018), while the remaining three focused on mobile devices for skin cancer triage. In the post-COVID-19 pandemic onset group, two studies employed mobile devices for skin cancer triage, three for general skin diseases, and one (Heidemeyer et al., 2023) concentrated on follow-up for acne.

Seven of the included studies presented general satisfaction either as a percentage or by counting the number of satisfied patients' responses, which was then converted into a percentage. One study (Damsin et al., 2023) quantified general satisfaction as a fraction out of ten, while another study (Heidemeyer et al., 2023) utilized an 11-point visual analog scale to measure general satisfaction. Refer to Table 1 for details.

Table 1 Study characteristics

Study	Technology used	TD[1] level	Skin issue	Study design	TD[2] Model	Instruments	Score[*] (%)
Pre COVID-19							

Wang et al. (2018)	MedX app[3]. Android smartphone	Patient to dermatologist.	General skin diseases.	Cross-sectional survey	SAF[5]	Questionnaire	86
Po (Harvey) Chin et al. (2020)	Moleme & Line app, smartphone	Patient to dermatologist.	Skin cancer triage.	Cross-sectional survey	SAF	Questionnaire	94
Gilling et al. (2020)	Fotofinder app, iPhone, Dermoscope	Skin GP[4] to dermatologist.	Skin cancer triage.	Cross-sectional survey	SAF	Questionnaire	59
Horsham et al. (2020)	Fotofinder app, iPhone, Dermoscope	Patient to dermatologist	Skin cancer triage.	Cross-sectional survey	SAF	Questionnaire	Nil
Post COVID-19							
Handa et al. (2021)	Smartphone, WhatsApp.	Skin GP to dermatologist.	General skin diseases.	Retrospective observational study	Hybrid	Questionnaire	61
Trinh et al (2022)	Skin IO app, iPad Pro, dermoscope.	Patient to dermatologist.	Skin cancer triage.	Cross-sectional survey.	Hybrid	Questionnaire	89
Yadav et al. (2022)	WhatsApp, smartphone.	Skin GP to dermatologist.	General skin diseases.	Cross-sectional survey.	Hybrid	Questionnaire, interview	84
Heidemeyer et al. (2023)	Evita app.	Patient to dermatologist.	Acne.	Randomized open-label study.	SAF	Visual analog scale	8.2/11
Weeraphon, & Sirithanabadeekul (2023)	SkinX app, smartphone.	Patient to dermatologist.	General skin diseases.	Cross-sectional survey	Hybrid	Questionnaire	76
Damsin et al (2023)	iPod touch, dermoscope, smartphone.	Skin GP to dermatologist.	Skin cancer triage.	Cross-sectional survey	SAF	Questionnaire	8.8/10 8.9/10

[1]Teledermatology level, [2] Teledermatology model, [3]application, [4]General practitioner, [5]Store and forward. *General Satisfaction score,

Table 2 shows the factors that were either facilitators (Positive impact) or barriers (Negative impact) to satisfaction from the results and discussions of various studies across different domains divided into the pre- and post-COVID-19 onset periods.

While all studies referenced facilitators of satisfaction, it is noteworthy that some studies did not report any barriers to satisfaction.

Table 2 Factors facilitating or barring satisfaction from study results.

Study	Facilitators	Barriers

Pre-COVID-19 pandemic onset.		
Wang et al. (2018)	Fast data transfer. Images and text are well displayed; the application starts promptly. The transfer of evaluation results was fast.	None mentioned.
Po (Harvey) Chin et al. (2020)	Technical quality. Fast transfer of results. Easy to use.	None mentioned.
Gilling et al., 2020	Faster response time. Less waiting time.	Not confident with diagnosis using photographs compared to face-to-face encounters. Not comfortable with pictures of intimate areas e.g., genitals.
Horsham et al. (2020)	Motivation to carry out regular skin checks. Dermatoscopy phone attachments were easy to use for skin self-examination.	Difficulty photographing hard-to-reach areas. difficulty selecting lesions. Difficulty capturing clear images and uploading them. Coupling and uncoupling phone attachment.
Post- COVID-19 onset		
Handa et al. (2021)	Diagnosis of fungal and ectoparasitic infections. Time saved traveling by road. Convenient and user-friendly WhatsApp application. Improved access to care. Diagnosis of acne.	Poor connectivity. Information technology illiteracy. Believe their condition cannot be managed over the phone. New and follow-up patients.
Trinh et al. (2022)	Safer during the COVID-19 pandemic due to the ability to maintain social distancing. Reduced waiting time from 58 to 24 days. Assists Immobile patients.	New clinic patients. Aged patient population.
Yadav et al. (2022)	Time saved traveling to the hospital. Follow-up patients. Diagnosis of Urticaria and improvement of skin disease had a statistical association with satisfaction	Lack of confidence with the photography diagnosis. Poor communication with doctors.
Heidemeyer et al. (2023)	Follow-up patients. A lower incidence of side effects. Fast response from dermatologists. Less time spent on consultation.	None stated
Weeraphon, & Sirithanabadeekul (2023)	SkinX application was fast and convenient. Most patients were confident with skin doctors and most comfortable with the cost.	None stated
Damsin et al. (2023)	Comfort with the procedure. Trust in advice given via tele-consults. Faster response time. Convenience, easy implementation.	None stated

Table 3 below shows the qualitative responses gathered from the three studies that conducted qualitative assessments of patient satisfaction. These responses provided deeper insights into the factors serving as either barriers (negative impact) or facilitators (positive impact) to patient satisfaction in utilizing mobile teledermatology for accessing care both before and after the COVID-19 pandemic.

Table 3 Qualitative questions, responses themes, and conclusions of facilitators/ barriers of satisfaction

Study	Questions	Theme of response	Facilitators	Barriers
Pre COVID-19 onset				
Horsham et al. (2020)	"Benefits of mobile teledermoscopy enhanced skin self-examination include?"	would benefit the rural underserved, a source of motivation that was easy to use.	The ease of use.	The underserved would need it more.
	"Issues with mobile teledermoscopy enhanced Skin self-examination include?"	Unsure of lesions to photograph and needed assistance to operate dermoscope. The inconvenience of coupling and uncoupling.	Feeling it was a good idea.	Lack of confidence. Technical Inconvenience.
Post COVID-19 onset				
Handa et al. (2021)	Subjective comparison of teledermatology vis-à-vis in-person visits?"	More patients felt in-person visits were better. Many patients believed their problems couldn't be handled over the phone.	Nil	Preference for face-to-face visits.
Yadav et al. (2022)	Receiving Drs. Call. Buying medicine through a WhatsApp or SMS prescription. Quality of care.	Inconvenient timing, waiting for calls, no specific time for calls. Non-honoring of E-prescriptions. Doubts of care quality inability to carry out medical procedures. Used for the COVID period only	Fewer prescription errors.	Inconvenient call timing, E-prescriptions were not acceptable. Quality of care is not the same as physical visits.
	Conveying problems to Dr., understanding his advice, and his understanding of the patient's problem	Limited consultation time, poor rapport, inability to explain problems. Lack of confidence that the Dr. understands problems from pictures. yearning for video calls. Feels Dr. gives	nil	Poor rapport. Lack of confidence in photographic assessment. Phone calls are not effective for communicating problems
	Clicking and sending photographs. Taking appointments.	Privacy issues for women, photos of hard-to-reach areas are difficult. Website keeps hanging	nil	Self-photography is difficult. Connectivity. Privacy for women.
	Taking appointments	The process of booking appointments is tedious and complex. Difficult for the aged and those with low IT[1] literacy.		Lack of IT literacy, Age
	Cost Direct/indirect	Increased productivity. The increased cost of medications. No more free medications from the hospital.	Timesaving.	Increased direct cost-making cost-effectiveness relative

[1]Information technology

4.2 Discussion

4.2.1 General satisfaction scores

The range of general satisfaction scores before the COVID-19 onset spanned from 59% to 94% (lowest to highest score), whereas post-COVID-19 onset ranged from 61% to 89% (lowest to highest score).

It cannot be categorically stated that there is a significant difference or stability in the satisfaction scores between the pre- and post-pandemic onset periods based on this range of scores. A possible explanation

might be the small number of eligible studies. The observed wide range of scores pre-onset of the pandemic might be due to the variability of experiences and opinions among the respondents.

One of the included studies (Damsin et al., 2023) utilized a general satisfaction question, albeit with scores presented as fractions rather than percentages. This study, conducted in two phases before and after the COVID-19 pandemic onset, demonstrated stable satisfaction scores throughout both phases: 8.8/10 in the first phase and 8.9/10 in the second phase, which had a larger respondent pool. Factors contributing to positive satisfaction in this study included faster response times, convenience, and confidence in teleconsult advice provided via mobile teledermatology. Notably, no factors negatively impacting satisfaction were mentioned in this study.

Pre-onset of the COVID-19 pandemic, the highest score of 94% was seen in Po (Harvey) Chin et al. (2020), concerning skin cancer triage using a dermatoscope and aided by artificial intelligence; see Table 1. The factors impacted positive satisfaction in this study included fast transmission of results, and reliable connectivity, which was also responsible for fast data transfer, as also seen in another study pre-pandemic onset (Wang et al., 2018), with a general score of 86%, and ease of use. The fast transfer of results was also emphasized in two other pre-pandemic onset studies (Wang et al., 2018; Gilling et al., 2020), thus buttressing the importance of speed in enhancing patient satisfaction. There were no factors responsible for dissatisfaction stated in this study and likewise (Wang et al., 2018); see Table 2.

The study with the lowest score of 59% pre-onset of the COVID-19 pandemic (Gilling et al., 2020) also involved skin cancer triage using a dermatoscope without the aid of artificial intelligence; see Table 1. Factors negatively affecting satisfaction were a lack of confidence in the diagnostic concordance between teledermatology and face-to-face consultations and privacy concerns with photography, especially of genital areas; see Table 2.

Post-onset of the COVID-19 pandemic, the study with the highest score of 89% (Trinh et al., 2022) also involved the use of a dermatoscope and an artificial intelligence-based application for skin cancer triage, as seen in Table 1. Factors positively affecting satisfaction, as detailed in the study, were related to the safety provided by teledermatology during the pandemic, reduced waiting time, and its ability to assist immobile patients. There were no factors mentioned to significantly reduce satisfaction, as indicated in Table 2. In another study (Yadav et al., 2022) with a score of 84%, factors positively affecting satisfaction included the ability to save time for patients and the type of diagnosis made using mobile teledermatology.

The study with the lowest score of 61% post-onset of the pandemic involved general dermatology diseases (Handa et al., 2021). Factors such as poor connectivity, a lack of information technology literacy, and a lack of confidence in photographic diagnosis and management negatively affected satisfaction. Another study post-pandemic onset (Yadav et al., 2022) cited inconvenient call timing, poor rapport, lack of confidence in diagnostic concordance with face-to-face consultations, connectivity issues, privacy concerns, lack of information technology literacy, and increased direct costs as factors that negatively impacted patient satisfaction.

4.2.2 Factors Affecting Satisfaction according to Domains

The domain of technical quality showed identifiable factors affecting satisfaction pre-onset of the COVID-19 pandemic, such as the speed of the mobile application and image transfer (Wang et al., 2018), which positively impacted satisfaction. Post-pandemic onset, issues of connectivity (Handa et al., 2021; Yadav et al., 2022), along with the complexity of applications for appointment booking (Yadav et al., 2022), had a negative impact on satisfaction. These negative impacts could be attributed to the increased number of individuals post-pandemic onset utilizing mobile networks (Handa et al., 2021), possibly straining such services and leading to poor bandwidth, which could affect the seamless utilization of the LI modality (Lee et al., 2018; Santiago et al., 2023) utilized more post-pandemic onset (Santiago et al., 2023) compared to the

pre-pandemic period (Hadeler et al., 2021; Horsham et al., 2020). An interesting point to note was that pre- and post-pandemic onset, studies incorporating artificial intelligence into applications (Po (Harvey) Chin et al., 2020; Trinh et al., 2023) to aid diagnostic capability had higher general satisfaction scores.

The usability and ease of use domains positively impacted satisfaction pre-pandemic onset, with user-friendly applications (Wang et al., 2018) and overall ease of application usage (Po (Harvey) Chin et al., 2020; Horsham et al., 2020). Conversely, factors related to usability negatively affected satisfaction for some individuals, particularly difficulties in photographing hard-to-reach areas, capturing clear images, and uploading them, as well as challenges in attaching and detaching phone accessories (Horsham et al., 2020). Following the pandemic onset, the ease of implementation of mobile interventions (Damsin et al., 2023) and the alleviation of patient responsibility for photography (Trinh et al., 2022) positively impacted satisfaction. Despite no significant association between satisfaction and age observed pre- (Handa et al., 2021) and post-pandemic onset (Yadav et al., 2022), age remains a consideration. Younger age groups demonstrated a higher likelihood of utilizing mobile teledermatology due to greater familiarity with mobile phones (Mu et al., 2021). Conversely, older individuals may find new technology complex (Yadav et al., 2022), potentially affecting satisfaction. Previous research has indicated that older individuals' satisfaction may be hindered by their lack of IT proficiency (Garfan et al., 2021), with technological challenges directly linked to dissatisfaction with teledermatology (Santiago et al., 2023). However, Trinh et al.'s (2023) study, primarily comprising elderly individuals, reported high satisfaction, likely attributed to the method of teledermatology delivery employed, underscoring the importance and interconnectedness of various satisfaction domains.

The domain of interpersonal interactions positively impacted satisfaction pre-pandemic onset, with ease of communication between patients and providers noted as a contributing factor (Wang et al., 2018). However, post-pandemic onset, respondents highlighted several factors that affected interpersonal interactions negatively, including hurried consultations, difficulty articulating concerns over the phone, apprehension about the understanding of concerns, and lack of continuity due to new providers for each follow-up consultation (Yadav et al., 2022); see Table 3. This lack of synergy with electronic medical records may lead to fragmented care and reduced satisfaction (Chuchvara et al., 2020). Particularly, respondents expressed dissatisfaction with voice phone calls for hybrid visits, suggesting that a video component would enhance satisfaction by providing a pseudo-physical presence during encounters, a factor previously associated with improved satisfaction in teledermatology (Santiago et al., 2023).

Although no statistical relationship was explored regarding the impact of follow-up or new patients on satisfaction, studies conducted both pre- and post-pandemic onset revealed that populations consisting mainly of follow-up patients reported higher general satisfaction scores (Wang et al., 2018; Yadav et al., 2023; Heidemeyer et al., 2023) compared to those including new patients as well (Handa et al., 2021). This trend aligns with findings from a recent review, which suggests that satisfaction may be linked to the thoroughness of a physical examination, often only achievable during an initial in-person encounter (Santiago et al., 2023). Therefore, the higher satisfaction observed among follow-up patients may be attributed to the already-established rapport and the initial "personal touch" experienced during previous interactions.

The domain of cost/finance was found to positively affect satisfaction pre-onset of the pandemic (Wang et al., 2018). However, post-onset of the pandemic, there was apparent dissatisfaction with the associated cost (Weeraphorn, & Sirithanabadeekul, 2023); see Table 4. This dissatisfaction could be attributed to the different demographics and geographical locations of the respondents, with significant variations in individual income levels (Santiago et al., 2023). The negative impact of cost was associated with the fact that patients had to purchase medications at higher rates closer to their homes, which would have been available for free in hospitals (Yadav et al., 2022); see Table 3. Additionally, due to the lockdowns, they had to rely on delivery services to access such medications, leading to additional costs, thus negating the

expected direct cost reduction associated with telemedicine (Lee et al., 2018). Moreover, the non-honoring of e-prescriptions by drug dispensaries would have exacerbated the situation for patients, forcing them to travel and spend more on transportation to find a pharmacy willing to honor such prescriptions.

The domain of impact on the daily lives of respondents was observed in the factor of time, which was a common consideration across both periods. Both the response time and the time-saving attributes of mobile teledermatology were influential. Pre- and post-onset of the pandemic, the swift response time of the service enhanced satisfaction (Wang et al., 2018; Damsin et al., 2023). The rapid transfer of screening results also contributed to satisfaction pre-pandemic onset (Po (Harvey) Chin et al., 2020; Gilling et al., 2020), while post-pandemic onset, the time saved traveling to the hospital (Handa et al., 2021; Yadav et al., 2022), longer duration of consultations (Heidemeyer et al., 2023), and shorter waiting times (Trinh et al., 2022) positively impacted satisfaction. The post-pandemic onset period saw an increased number of patients registering for teledermatology care (Handa et al., 2021; Yadav et al., 2022). However, without sufficient time for proper planning on how to handle the increased load and schedule consultations, complaints of prolonged waiting times for doctor calls may have arisen, a factor known to negatively impact patient satisfaction (Gong et al., 2022). Additionally, the inconvenient timing of the calls would further exacerbate this negative impact on satisfaction (Yadav et al., 2022); see Table 3.

The domain of efficacy encompassed factors related to confidence in lesion selection for self-photography in skin cancer triage, which negatively impacted satisfaction pre-pandemic onset, mainly due to concerns about sending incorrect lesions for assessment and potentially missing problematic lesions (Horsham et al., 2020). See Table 2. Lack of confidence in photographic diagnosis was a recurring factor both pre- (Gilling et al., 2020) and post-pandemic (Handa et al., 2021; Yadav et al., 2022); see Table 3. This underscores the issue of diagnostic concordance, extensively studied and found to be comparable with in-person diagnosis (Lamel et al., 2012; Ebner et al., 2008). Post-onset of the pandemic, a significant association was found between positive satisfaction and the diagnosis of urticaria, as well as in patients experiencing improvements in their skin conditions or treatment changes via teledermatology (Yadav et al., 2022); see Table 2. Higher satisfaction scores were noted in patients with acne, fungal, and ectoparasitic infections (Handa et al., 2022), likely because they are easier to diagnose via telemedicine.

Other factors identified include privacy concerns arising from the necessity to photograph intimate areas, which negatively affected satisfaction both pre- (Gilling et al., 2020) and post- (Yadav et al., 2022) pandemic onset, particularly for women; see Table 2 and 3. This concern was previously observed, with a higher percentage of women expressing reservations about sending photographs of intimate areas (Kaliyadan et al., 2013). An important motivation for using teledermatology was the fear of contracting the COVID-19 virus, as telehealth ensured social distancing and facilitated access to care for immobile patients (Trinh et al., 2022).

Mobile devices and their software applications have increased access to dermatology care, as evidenced by patients seeking care from longer distances (Handa et al., 2021; Yadav et al., 2022). Their instant messaging software applications are widely used and have a broad reach, making them easily deployable tools in times of compulsory or unforeseen circumstances to reduce the access gap to care. Medical applications can be integrated into these instant messaging software applications to seamlessly ensure their usability for delivering dermatology care. Their versatility in supporting telephony, live interactive, and store-and-forward methods of care delivery makes it easier to address connectivity issues by simply switching between different delivery modalities within the same application/device.

To enhance the teledermatology consultation system using mobile devices, we suggest several recommendations. Firstly, applications utilized for mobile teledermatology and telemedicine in general should be designed to integrate seamlessly with electronic medical records and other stakeholders in the

healthcare ecosystem, particularly pharmaceutical services. Additionally, mobile application developers should strive to ensure compatibility across all available operating systems. The adoption of a hybrid approach incorporating live interactive video components should be promoted whenever possible. Furthermore, there should be a focus on developing user-friendly interfaces for patient booking and interaction within these applications, particularly catering to the needs of elderly users. In times of routine healthcare delivery, mobile teledermatology should primarily be utilized for follow-up consultations, unless geographical distance poses a significant barrier to care. Lastly, standardized training protocols should be established to educate physicians on conducting effective mobile teledermatology consultations, thereby improving communication and interpersonal relationships with patients.

Due to the limitations of the small sample size of studies focusing on mobile teledermatology and the high variability among respondents in the included studies, pooling statistical analysis could not be done to compare the scores of the two periods as intended to determine if the pandemic did affect the satisfaction scores. Our review could be the first attempt to compare satisfaction with mobile teledermatology for two periods because an exhaustive literature search did not find other studies that made this comparison. This also made it difficult to compare with previous research. Also, we had a time limitation for our search for included studies: 3 years pre- and post-onset of the COVID-19 pandemic.

5. Conclusion

In conclusion, both pre- and post-onset of the COVID-19 pandemic, patients generally expressed satisfaction with teledermatology utilizing mobile devices. Factors contributing to positive satisfaction pre-pandemic onset included rapid transmission of results, prompt response times, and dependable connectivity. Conversely, post-pandemic onset, issues such as connectivity challenges, application complexity, age-related barriers, IT literacy, communication difficulties, fragmented care, cost concerns, and gaps in the health value chain were identified as contributors to diminished satisfaction. Common factors influencing satisfaction across both periods included follow-up patient care, time efficiency, challenges with self-photography, and extensive mobile phone usage.

Further research should be conducted as more studies become available to facilitate potential statistical analysis comparing the data between these two periods. Additionally, future studies should explore the impact of artificial intelligence-based applications on patient satisfaction in teledermatology.

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